

Decision Rationale

Total Maximum Daily Load for the Aquatic Life Use Impairment on Spring Branch Sussex County, Virginia

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water-quality limited water body.

This document will set forth the U. S. Environmental Protection Agency's (EPA) rationale for approving the TMDL for the aquatic life use impairment on Spring Branch. EPA's rationale is based on the determination that the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

- 1) The TMDL is designed to implement applicable water quality standards.
- 2) The TMDL includes a total allowable load as well as individual waste load allocations (WLAs) and load allocations (LAs).
- 3) The TMDL considers the impacts of background pollutant contributions.
- 4) The TMDL considers critical environmental conditions.
- 5) The TMDL considers seasonal environmental variations.
- 6) The TMDL includes a margin of safety (MOS).
- 7) There is reasonable assurance that the TMDL can be met.
- 8) The TMDL has been subject to public participation.

II. Background

The Spring Branch Watershed is located in Sussex County, Virginia. Spring Branch is a tributary to the Blackwater River in the Chowan River Basin. The benthic impairment on Spring Branch extends 3.72 miles from the upstream discharge of the former Borden Chemical Waverly Plant to the mouth of Spring Branch. The 3,700-acre watershed is rural with forested and agricultural land making up 94 percent of the watershed. The remainder of the watershed is composed of developed land.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental

Quality (VADEQ) listed Spring Branch (VAP-K32R) on Virginia's 1998 Section 303(d) list as being unable to attain the general standard due to an aquatic life use impairment identified through benthic assessments. This decision rationale will address the TMDL for the aquatic life use impairments.

To assess the biological integrity of a stream, Virginia uses EPA's Rapid Bioassessment Protocol II (RBPII) to determine status of a stream's benthic macroinvertebrate community.¹ This approach evaluates the benthic macroinvertebrate community between a monitoring site and its reference station. Measurements of the benthic community, called metrics, are used to identify differences between monitored and reference stations.² The state is currently in the process of changing this methodology to a stream condition index (SCI) approach. The Coastal Plain Metric Index (CPMI) was used to assess Spring Branch as well. The CPMI is similar to the SCI but was developed to be used in the low relief areas of eastern Virginia.

As part of the RBPII approach, reference stations are established on streams which are minimally impacted by humans and have a healthy benthic community. These reference stations represent the desired community for the monitored sites. Monitored sites are evaluated as non-impaired, slightly impaired, moderately impaired, or severely impaired based on a comparison of the biological community of the reference and monitored sites. Streams that are classified as moderately (after a confirmatory assessment) or severely impaired after an RBPII evaluation are classified as impaired and are placed on the Section 303(d) list of impaired waters.

The most upstream monitoring station on Spring Branch was used as the reference station for the RBPII assessments from 1994 through 1998. The reference station was intermittent in nature which made it difficult to conduct RBPII assessments. However, a more suitable reference station could not be found and modifications were made to RBPII to account for this. From 1994 through 1998 the three monitoring stations on Spring Branch were evaluated as either moderately or severely impaired. In the 2004 and 2005 assessments, an improvement was seen in the three downstream monitoring stations. Upgrades were made to a discharge in the watershed in 2003 and may have accounted for the improvement. A new reference station on Warwick Swamp was used in these assessments and it may also be impaired as it scored below the impairment threshold on the CPMI.

The benthic data was also run against the CPMI which found all of the sites to be impaired although an improvement was seen in the Fall of 2004 on almost all stations. There are two point sources that historically discharged to Spring Branch. The facilities are the former Borden site and the Sussex County Sanitary Authority sewage treatment plant (STP). The Sussex facility discharges to the lower segment. The facility discharged primary treated wastes

¹Tetra Tech 2002. Total Maximum Daily Load (TMDL) Development for Blacks Run and Cooks Creek. Fairfax, Virginia.

²Ibid 1

to Spring Branch as the Waverly STP until 1976. From 1976 through 2003, although the facility was upgraded it still discharged solids in excess of its permit to Spring Branch. In 2003 the facility was expanded and upgraded and ownership was transferred to the Sussex County Service Authority. The former Borden Site is located on a tributary to Spring Branch in the upper watershed around river mile 3.70. The stream here is impacted by the facility's former discharge and natural conditions of swamp waters. It is believed that the former Borden site may still be releasing excess nitrogen to the system. VADEQ is currently working with the former owner to evaluate and remediate these potential releases. Comparing the historic to the current water quality data in Spring Branch (Chapter 3 of the TMDL Report) reveals that the nitrogen and ammonia concentrations have been reduced. However, the upper watershed is still seen as being impacted by natural conditions and possibly the former Borden site. The TMDL focused on restoring the benthic health in the lower Spring Branch.

The RBPII analysis assesses the health of the macroinvertebrate community of a stream. The analysis will inform the biologist if the stream's benthic community is impaired. However, it will not inform the biologist as to what is necessarily causing the degradation of the benthic community. Additional analysis may be required to determine the pollutants which are causing the impairment as information can be gleaned based on the composition of the community and the condition of the habitat. TMDL development requires the identification of impairment causes and the establishment of numeric endpoints that will allow for the attainment of designated uses and water quality criteria.³

Even with the historic information on the problems associated with Spring Branch, it was necessary to determine what pollutant was impacting the watershed. All possible stressors were evaluated against Virginia's applicable numeric water quality criteria or guidance thresholds. Based on the water quality data, dissolved oxygen (DO) impairments frequently occurred in the Spring Branch watershed. Although these violations did not occur at the monitoring station on river mile 0.65, the mouth of Bryant Pond, it is believed that DO violations caused by excess phosphorous loading are impacting Spring Branch's benthic community. It is believed that the monitoring station, at river mile, 0.65 did not exhibit DO violations because the Sussex County Sanitary Authority STP (VA0061310) was discharging effluent with elevated DO concentrations, samples were mostly taken during daylight hours when photosynthesis occurs and water exited the pond via a 12 foot dam which re-aerated the water. However, the DO concentrations at this point did exhibit super saturated conditions which typically are caused by eutrophication and algal blooms and matting have been observed in the Pond. Phosphorous concentrations in the stream below the Sussex County Sanitary Authority STP were well above the VADEQ's screening level of 0.2 mg/L, often by a factor of five.

Phosphorous impacts the DO concentration by providing a fuel for increased primary production. When primary production occurs at unsustainable levels, the DO concentrations experience a daily cycle of highs and lows. During daylight hours, primary producers release

³Ibid 1

oxygen as part of photosynthesis. In the evening and early morning hours, these same organisms consume oxygen through respiration. In a nutrient enriched system, the DO concentrations can be extremely high during daylight hours (above even the saturation rate) and come crashing down during nighttime hours when primary producers consume DO. Both the low DO levels in evening hours and the swing in DO concentrations are detrimental to the aquatic community.

The TMDL analysis viewed Spring Branch as two watersheds, the upper watershed above the monitoring station at river mile 1.99 which is impacted from natural conditions and historical contamination from the old Borden site and the lower watershed above the monitoring station at river mile 1.24 is being impacted by excessive phosphorous from the STP and other sources. The TMDL did not call for nitrogen controls above river mile 1.99. Reductions in phosphorous loading were called for in the lower watershed, and these were based on bringing lower eutrophic conditions to Bryant Pond, reducing algal blooms.

The benthic TMDL was developed using the EUTROMOD (eutrophication model). The EUTROMOD model is a nutrient loading and lake response model. Two equations are used in the model to quantify the annual runoff volume (rational equation) and sediment loss (universal soil loss equation). The model uses these calculations to determine the dissolved and sediment bound phosphorous loads. Precipitation and weather data for the model was obtained from the National Climatic Data Center in Wakefield, Virginia. Slope and elevation data was also fed into the model and plays an important role in runoff and erosion rates. The pond surface area, mean depth and lake evaporation were also needed in the modeling of Bryant Pond. The model was run and allocations developed to insure the total phosphorous concentration in the pond was at or below 48.1 ug/L. This concentration was equal to a Carlson's Trophic State Index (TSI) score of 60 which is the lower bounds of eutrophic conditions.

Table 1 - Summarizes the Specific Elements of the TMDL.

Segment	Parameter	TMDL	WLA	LA	MOS
Spring Branch	phosphorous (kg/yr)	193	145	47	Implicit

The United States Fish and Wildlife Service has been provided with copy of the TMDL.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing an aquatic life (benthic) use impairment TMDL for Spring Branch. EPA is therefore approving the TMDL. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

As stated above, the biological assessments on Spring Branch documented that a benthic impairment existed on the stream. These assessments were modified due to the difficulties associated with the reference site. The benthic assessments did not discern a stressor to Spring Branch and a stressor identification study was therefore conducted. As stated above, an excessive phosphorous load is impacting the DO concentrations in Spring Branch and the algal growth and pH levels in Bryant Pond. Bryant Pond is located in the lower watershed at river mile 0.65 as such it represents an excellent yardstick for the assessment of the system. The goal of this TMDL was to restore the pond to a minimally eutrophic condition, and if this was to be achieved, the lower watershed would no longer be impaired. Bryant Pond is collecting and storing the nutrient load from the watershed and in order to bring the pond to a more appropriate condition, changes would be required throughout the watershed. The TMDL endpoint was a TSI score of 60 which is the lower bounds of eutrophic conditions and corresponds to a total phosphorous concentration of 48.1 ug/L.

Once the endpoint was determined, it was necessary to find a model that would be able to quantify the phosphorous loading to Spring Branch and its concentration within Spring Branch. The EUTROMOD was found to be the model of choice and it was able to quantify the appropriate load of phosphorous. Two equations are used in the model to quantify the annual runoff volume (rational equation) and sediment loss (universal soil loss equation). The water quality model was calibrated to in-stream monitoring data collected at river mile 1.24. The model is described in more detail in Chapter 4 of the TMDL. It is believed that by reducing the total phosphorous load in the watershed, a healthy aquatic assemblage can be brought back to the lower watershed through the maintenance of the appropriate DO concentrations.

2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of phosphorous to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be found in Table 1 of this document. The total allowable load is calculated on an annual basis.

Waste Load Allocations

There is one facility actively discharging phosphorous to Spring Branch at this time. The facility is the Sussex County Sanitary Authority STP and it discharges treated wastewater to the stream. As mentioned above, improvements have occurred at this facility but based on the TMDL modeling and observed water quality data, further reductions are needed. The TMDL called for an 83 percent reduction in phosphorous from the facility as documented in Table 2.

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), “Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7.” Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Table #2 – WLA for Phosphorous for Spring Branch

Facility	Permit Number	Existing Load (kg/yr)	Allocated Load (kg/yr)	Percent Reduction
Sussex County Sanitary Authority STP	VA0061310	872	145	83

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished. The EUTROMOD model was used to ascertain the phosphorous loading to Spring Branch. The model provides the phosphorous load to the stream through the use of the universal soil loss equation (USLE). The USLE derives the phosphorous loading by using information on precipitation rates, best management practices, land slope, and vegetative cover. Table 3 identifies the current and TMDL loading for phosphorous to Spring Branch.

Table 3 - LA for Phosphorous for Spring Branch

Source Category	Existing Load (kg/yr)	Proposed Load (kg/yr)	Percent Reduction
Forest	6	6	0
Agriculture	251	42	83
Former Borden Site	0.89	0.15	83
Developed	0.5	0.09	83
Failing Septic Systems	66	0	100
Sewer Line Leak	36	0	100

3) *The TMDL considers the impacts of background pollution.*

The TMDL considers the impact of background pollutants by considering the

phosphorous loadings from background sources such as forested land.

4) The TMDL considers critical environmental conditions.

According to EPA's regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Spring Branch is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards⁴. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The model was run over a multi-year period to insure that it accounted for a wide range of climatic conditions. The allocations developed in this TMDL will therefore insure that the criterion is attained over a wide range of environmental conditions including wet and dry weather conditions.

5) The TMDL considers seasonal environmental variations.

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Consistent with the discussion regarding critical conditions, the model and TMDL analysis effectively considered seasonal environmental variations through the use of observed weather data over an extended period of time and by modifying waste application rates, crop cycles, and livestock practices.

6) The TMDL includes a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using

⁴EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. An implicit MOS was used for the TMDL by targeting Bryant Pond to the lower range of eutrophication.

7) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program.

8) The TMDL has been subject to public participation.

During the development of the TMDL for Spring Branch, public meetings were held to discuss and disseminate the TMDL. A basic description of the TMDL process and the agencies involved was presented at the first public meeting on April 18, 2005 at the Beaverdam Sportsman's Club in Waverly, Virginia with 16 people in attendance. The second and final public meeting was held on August 25, 2005 at the Waverly Town Hall in Waverly, Virginia with 15 people in attendance. Notices for the public meetings were placed in the Virginia Register and the Sussex Surry Dispatch. Both meetings were open to a 30-day public comment period and comments were received and responded to by the state.